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Racial and ethnic disparities in low birth weight delivery associated with maternal occupational characteristics

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Abstract

Objectives—Work characteristics and maternal education have both been associated with low birth weight (LBW) delivery. We sought to examine the relative contribution of these two factors to LBW delivery and determine whether ethnic/racial differentials in educational attainment and work characteristics might play a role in well-described disparities in LBW.

Methods—Scores for work substantive complexity (SC) derived from the O*NET were imputed to maternal occupation for Connecticut singleton births in 2000. Risks for LBW were estimated separately for black, Hispanic, and white mothers using logistic regression controlling for maternal covariates.

Results—Using white mothers as a referent, working is associated with reduced LBW risk in black mothers compared to those not in work (OR 2.06 vs 3.07). LBW in working black women was strongly associated with less than a high-school education 4.80 (1.68 – 13.7), and with low work SC in blacks in those with a college education or greater (OR 4.48, 95% CI 1.24 – 16.2). Examination of work SC scores, controlling for age and educational level, showed lower values for blacks; increased work SC was seen in Hispanics after adjustment for lower educational attainment. A decrease in risk for LBW was seen in black mothers, compared with whites, as work SC increased. By contrast, college-educated black mothers had a greater risk for LBW than those with high-school or some college education.

Conclusions—Maternal employment and work in a job with greater SC were associated with a reduced risk of LBW in black mothers. Improved LBW risk was also seen with employment in Hispanics. Low work SC in those with higher educational attainment was strongly associated with LBW in blacks, but not whites or Hispanics. Education/work mismatch may play a role in racial disparities in birth outcomes.

INTRODUCTION

Many studies have reported socioeconomic status (SES) gradients in perinatal health outcomes both between and within ethnic groups. Although results vary by the adverse birth indicator used, they are so consistent as to make the observed disparities an area of great public health concern [Parker, et al. 1994, Collins and Butler 1997, Braveman, et al. 2001,

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Rauh, et al. 2001, Finch 2003, Leslie, et al. 2003, Nicolaidis, et al. 2004, Savitz, et al. 2004]. Substantial disparities in birth weight and the incidence of low birth weight (LBW) and prematurity between black and white infants have been documented across the past decade, with evidence that the gap is widening [Rauh, et al. 2001, Finch 2003, David and Collins 1997, Stewart, et al. 2007]. SES measured at the time of pregnancy, differential health behaviors during pregnancy, and inadequate utilization of prenatal care have not fully explained the differences between black and non-Hispanic white women [Schempf, et al. 2007]. Association between traditional SES measures (principally education and income) and the risk of LBW has received the most attention in the literature. Studies of ethnically diverse populations of childbearing women provide evidence that LBW risks are patterned by education, and strong gradients are often reported when SES is operationalized as education [Parker, et al. 1994, Braveman, et al. 2001, Leslie, et al. 2003]. However, this pattern does not universally hold. In separate analyses by race/ethnicity, educational gradients present in white mothers are often attenuated or absent in blacks [Nicolaidis, et al. 2004, Savitz, et al. 2004, David and Collins 1997]. Disparities in birth weight persist, even in black women of high educational attainment and SES, when birth outcomes in black college graduates are compared to their white counterparts [Collins and Butler 1997, McGrady, et al. 1992, Schoendorf, et al. 1992, Colen, et al. 2006].

Other studies, using a life-course framework, demonstrate that childhood early-life experiences, adult social class, neighborhood, and chronic poverty among black women are influential in birth outcomes, suggesting longstanding structural disparities and maternal disadvantage extending inter-generationally [Rauh, et al. 2001, Krieger, et al. 2003, Astone, et al. 2007]. Evidence of declines in birthweight occurring with even modest increases in maternal age in blacks have been contrasted with an absence of similar findings in whites; this phenomenon has been attributed to cumulative effects of poverty, reduced opportunities and discrimination, and is termed “weathering” for its erosive long-term effect upon health [Geronimus 1996]. Overall, these studies suggest, as do some researchers and commentators, [Savitz, et al. 2004, Kaufman, et al. 1997, Savitz, et al. 2006] that “adjustment” for race/ethnicity, and the consequent interpretation of this variable as a risk factor for adverse pregnancy outcomes, misses or obscures important sources of between-group variation in exposures or risk factors, or differing pathways toward outcomes.

Recognition of the psychosocial stresses of the workplace as potential contributors to ill-health has increased in the past two decades. Outcomes, including hypertension and cardiovascular disease [Muntaner, et al. 1998, Landsbergis 2001, Kuper and Marmot 2003] and musculoskeletal disorders [Warren, et al. 2000, Warren 2001] have been associated with the organization of work and the disparity between psychological work demands and the degree of worker control in meeting them. The relevance of psychosocial and work organizational factors to adverse pregnancy outcomes in working women has been posited, but remains elusive [Hogue 2001]. Indices of job strain (operationalized most commonly as the combination of high work demands with low control over the conditions of work [Schwartz, et al. 1988, Karasek, et al. 1998]) have demonstrated a variable relationship to poor pregnancy outcomes, with conflicting study results. A lack of association between job strain measures and adverse pregnancy outcomes has been noted in several studies [Homer, et al. 1990, Ceron-Mireles 1996, Escriba-Aguir 2001]. By contrast, Brett and colleagues [1997] found indications of increased risk of preterm delivery associated with full-time work in a high-strain job after 30 weeks gestation, in addition to findings of a socioeconomic gradient, and increased risk in black compared to white working women. An overall association of high-demand/low control work with reduced birthweight was also noted in a prospective study among women presenting early for prenatal care, with black women faring worse than whites [Oths, et al. 2001]. A more recent study examined the relationship between birth outcomes and attributes of maternal work, [Bell, et al. 2007] using variables

extracted from the Work Context and Work Values of the O*NET database, stratifying by race/ethnicity. Status-recognition indices (including social status, authority, and planning one's own work) were associated with higher average birth weight and lower risk of fetal growth restriction. These studies suggest the possibility that specific work factors may increase poor outcomes in women with other adverse socioeconomic exposures.

The study described here arose from our earlier work that described the association of occupational psychosocial characteristics with low birth weight and premature delivery. Overall we found a modest increase in low birth weight and prematurity associated with two correlated factors: low job control and low substantive complexity of work [Meyer, et al. 2007]. We noted that associations of these factors with low birth weight were attenuated by adjustment for educational and demographic covariates, particularly by race/ethnicity. In the present study, we seek to investigate this finding further. Since one possible source for varying gradients in health outcomes may entail the translation of educational attainment into work with positive psychosocial and physical attributes [Davey Smith, et al. 1998, Singh-Manoux, et al. 2002, Kohn and Schooler 1973], our interest, based on these earlier findings and the prior literature, was whether our previously-observed associations of low birth weight with work and educational level reflected differences in occupational characteristics that are incongruent with educational attainment. We therefore examined our previous data on LBW to determine whether discrepancies between educational attainment and occupational characteristics varied by racial/ethnic group, and whether this disparity might be associated with increased risk for LBW delivery.

METHODS

We previously described our methods for analysis of the Connecticut birth dataset in an earlier publication [Meyer, et al. 2007]. Data from the Connecticut birth registry for the calendar year 2000 was obtained from the Connecticut Department of Public Health (CT DPH) as a text file after being stripped of maternal and infant personal identifiers, and converted into an SPSS data file (SPSS Inc. Chicago, IL. Version 15.0) for analysis. Data fields included in the Connecticut birth registry include infant birth weight, date of last menstrual period and gestational age, maternal age, race, ethnicity, occupation and industry, maternal tobacco use during pregnancy (yes/no), the month prenatal care was initiated and the number of prenatal visits, maternal education (years, up to 17), and history of previous live birth and stillbirth. We restricted the analysis to singleton deliveries at ≤44 weeks gestation in mothers who were 20 years of age or older only, to eliminate the effects of covariance between younger maternal age and low educational level [Schempf, et al. 2007]. Comparison of demographic variables and birth outcomes between working and non-working mothers is provided in our earlier paper [Meyer, et al. 2008].

Coding of maternal occupation and industry was performed using procedures and algorithms for standardized occupation and industry coding developed by the National Institute for Occupational Safety and Health (CDC/NIOSH) and the National Center for Health Statistics [Division of Vital Statistics 2003a, Division of Vital Statistics 2003b]. Occupation and industry were coded to three digits using the Bureau of the Census classification framework for the 2000 Census and aggregated into minor and major occupational groups, using crosswalks and guidance documents from the 2000 Census classification and the 2000 Standard Occupational Classification System of the Bureau of Labor Statistics [Division of Vital Statistics 2003a].

O*NET data on job attributes were downloaded from the O*NET Resource Center [O*NET Resource Center]. Job attribute measures for a total of 900 occupations were represented in this version of the O*NET, which supplanted the earlier Dictionary of Occupational Titles

(DOT). Two composite variables, termed s*ubstantive complexity*, and *physical demands*, were derived from the factor analysis described by Hadden and colleagues [Hadden, et al. 2004]. The variables were composed as an unweighted sum of the ten O*NET job attribute measures having the highest loadings on each factor. The main variable of interest was substantive complexity, composed of job-specific measures that assess deductive reasoning, updating and using relevant knowledge, inductive reasoning, complex problem solving, active learning, making decisions and solving problems, ability utilization, critical thinking, getting information, and low task repetition. A higher score reflects work that increasingly requires these attributes. A physical demands variable likewise represented a ten-item score on elements that include required stamina, reaction time, body equilibrium, limb movement, time spent sitting, and environmental controls at the workplace; high scores on this variable indicate greater physically demanding work. O*NET job titles were linked with 2000 census codes through occupational-code crosswalks [US Department of Labor 1998–2005], and scores for each factor were imputed to the maternal occupation noted in the birth dataset. Twenty-five mothers with an occupation in the armed forces were excluded from the occupational analyses, as O*NET scores for their military jobs were not available. Applied to the occupations of mothers in the Connecticut birth dataset, composite scores for substantive complexity yielded an approximately normal distribution (mean score 32.4, median 32.5, range 16.2 to 45.0). Scores for the two O*NET-based variables were grouped into tertiles based on their distribution in the dataset, with approximately equal numbers of subjects in each tertile.

Additional variables obtainable from the birth dataset were abstracted and coded for use as covariates in regression models. These variables resulted in a 5% or greater change in effect estimates for LBW in our previous studies [Meyer, et al. 2008]. Maternal age demonstrated an association with low birth weight at both extremes of age, as has been previously described in Connecticut [Shmueli and Cullen 1999], and its modeling as a quadratic variable provided the best fit in logistic regression. Educational level was categorized as college graduate (completion of 16 or more years education), high school graduate with or without some college education (12–15 years), or non-high-school graduate (<12 years). Delivery of a previous liveborn child was associated in the overall dataset with reduced risks of LBW and prematurity; a dichotomous variable was used to code for a previous delivery. An indicator variable was used to code trimester in which prenatal care was initiated.

Analyses were performed using SPSS v 15 (SPSS Inc, Chicago IL). Low birth weight (LBW) was defined as birth weight less than 2500 grams regardless of gestational age, and used as a dichotomous outcome measures in multivariate analyses. Multivariate logistic regression was used to calculate odds ratios for the association of LBW with the principal independent variables of interest (work substantive complexity and educational level) using models that control for other variables from the birth dataset, including maternal age, previous birth, initiation of prenatal care, and tobacco use in pregnancy. Interaction terms describing the joint risks of educational level and work substantive complexity were added using a backward-elimination stepwise method and retained in the final model if their significance (p value) was less than 0.1. Work physical demands were not independently associated with LBW in these analyses, therefore this variable was used to control for confounding of the effects of low substantive complexity work by high physical demands, which may be moderately correlated [Meyer, et al. 2007, MacDonald, et al. 2001]. Analyses were performed either separately by race to examine differences in effect of the variables of interest, or using white non-Hispanic women as the reference group for comparative analyses. 95% confidence intervals were calculated for estimates of effect. Human subjects research approval for this study was obtained from the Institutional Review Board of the University of Connecticut Health Center and the Human Investigations Committee of the Connecticut Department of Public Health.

RESULTS

The resultant dataset for analyses consisted of 34,490 singleton deliveries at 44 weeks gestation or less in mothers aged 20 or over with an occupation noted in the dataset. For non-Hispanic whites, 18,207 (71.3%) of 25,550 mothers had an occupation noted in the dataset, comparable figure for non-Hispanic blacks was 2,742 (68.9%) of 3,980 mothers and for Hispanics 2480 of 4960 (50.0%). Demographic characteristics of the mothers and birth outcomes by education and working status are shown in Tables I and II. Overall, non-Hispanic black and Hispanic women in the birth dataset were younger, more likely to have had a previous delivery, and initiated prenatal care in the first trimester less frequently. The proportion of non-Hispanic whites who had completed a college degree or further was three times greater than black or Hispanic women. Expected gradients in LBW were seen with educational level and work substantive complexity in both blacks and whites, with the greatest proportion of adverse outcomes seen in those not having completed high school, and those working in low SC jobs. Although the proportion of adverse outcomes in blacks was always higher than in whites for every education/work stratum in Table II, in most cases working black women had better outcomes than their non-working counterparts. Although the proportion of LBW delivery was greater in Hispanics than non-Hispanic whites, gradients by education or by work SC were not seen in working Hispanic women.

Crude and adjusted odds ratios for adverse birth outcomes comparing working and non-working black and white mothers are shown in Table III. Little change in risk estimates was evident after adjustment for age and other relevant covariates, while adjustment for educational level appreciably reduced the comparative odds ratios for LBW delivery in blacks and Hispanics. Educational gradients in risk for LBW were attenuated in all working women compared to the non-working. The increased risk of LBW experienced by black, and to a lesser extent, Hispanic women was more pronounced in women who were not currently working compared to those who were, and persisted after adjustment for educational level.

The attenuation of comparative risk that we saw in working, compared to non-working, black women led us to examine outcomes by work characteristics and education stratified by race/ethnicity. These are shown in Table IV. There is evidence of a modestly increased risk for LBW in working whites with education less than a college degree. By contrast, there is little evidence for increased risk for adverse birth outcomes in whites or Hispanics working in jobs with lower substantive complexity, nor does adjustment for this factor affect the estimation of risk by educational level in these two groups. Black mothers, by contrast, exhibit very different findings, with a considerably elevated LBW risk in non-high-school graduates, and increased risk for LBW in low substantive complexity work (for blacks within the lowest tertile of SC, odds ratio (OR) 1.66, 95% confidence interval (95%CI) 1.03 – 2.68). Moreover, a substantial gradient is seen in blacks when the interaction between work in a low substantive complexity job and educational attainment is introduced into the model. College-educated black mothers in low SC work exhibited a considerably elevated risk for LBW (OR 4.48, 95% CI 1.24 – 16.2) and those with at least a high-school diploma also had an elevated risk (OR 2.75, 95% CI 0.90 – 8.41), although this latter estimate was of borderline statistical significance ($p<0.08$). No similar interaction terms approached statistical significance for LBW risk in white and Hispanic mothers and hence were not included in the final models for these two groups in Table III.

The differences in risk estimates by race/ethnicity that we see for low substantive complexity work, which appears most strongly associated with black women of higher educational attainment, suggests that that access to work congruent with past attainment may be reduced in black women. Paradoxically, however, this finding was not seen in Hispanics, despite their similarity to blacks in the proportion of mothers working in lower SC jobs. In

Table V we examine predictors of work SC with potential relevance to this paradox. As expected, maternal age and education exhibit a positive association with SC, with both black and Hispanic mothers having lower adjusted baseline levels of SC compared to whites (regression coefficients of −1.7 and −1.4 respectively). Once adjusted for the significantly lower levels of educational attainment in Hispanic mothers (the interaction term 'Hispanic by Education' in Model 3) the discrepancy in baseline SC between whites and Hispanics is reversed, with a now-positive coefficient (4.1) for Hispanic ethnicity. Inclusion of a similar interaction for black mothers and education was not statistically significant, and did not improve the overall predictive value (R-squared) of the model, nor did it change the negative coefficient for black mothers. Similar to other investigators' findings [Miech, et al. 2003], these results suggest the comparability of work obtained by white and Hispanic women in our dataset once a lower baseline of educational attainment in Hispanics is taken into account. By contrast, the persistently negative coefficient for work SC in black women indicates a substantial differential between blacks and whites that is not accounted for by lower educational attainment.

Comparisons of risk for adverse outcomes between racial/ethnic groups at equivalent levels of work substantive complexity and educational attainment are shown in Table VI, each mutually adjusted for the other factor. Although risk estimates for all outcomes remain elevated for the most part in blacks over whites within occupational or educational strata, there are notably different patterns of risk. As work substantive complexity increases, a monotonic decline is seen in risk in blacks, relative to whites; risk is reduced by over half for blacks compared with whites across tertiles of this factor (aOR 1.53 for high SC work, versus 2.33 in low SC, after adjustment for education and other covariates). Contrasts in risk for LBW are higher for blacks with a college education, compared to college-educated whites, than are seen in the group with a high-school diploma/some college (12–15 years education). Comparative risks in Hispanics are considerably lower than those in blacks, without the evidence for a gradient in risk by work substantive complexity that was noted in blacks.

DISCUSSION

Our previous work examining maternal occupation and occupational characteristics had found only modest evidence of an effect of substantive complexity on pregnancy outcomes using the overall Connecticut birth dataset [Meyer, et al. 2007]. As well, we noted a small protective effect of working on birth outcomes, which disappeared following adjustment for relevant covariates, particularly education, as well as race/ethnicity [Meyer, et al. 2008]. By contrast, when the data are examined separately by reported race/ethnicity, we find very distinct patterns. Our analyses suggest reductions in risk for LBW in working black and Hispanic mothers relative to their non-working counterparts, that is independent of differences in other maternal characteristics which could covary with work status, such as age or smoking. Additionally, within our working population we find differential effects of work and education when black and white subjects are analyzed separately. In whites, there is some evidence for reduced risk for LBW with increasing education, with essentially no attenuation of the effects of education by the substantive complexity of current work. A stronger effect of work substantive complexity is seen in black mothers, which appears to be a consequence of a discrepancy between higher educational attainment and reduced substantive complexity of work. The effects of these two factors are more striking when stratified comparisons are made between outcomes in black and white mothers, with evidence that increasing substantive complexity is associated with decreasing risk in blacks, while high risk in blacks persists or increases with high educational attainment, compared to whites.

Although our previous work showed little evidence for differences in outcomes between working and non-working women in the overall dataset, stratified analyses by race show evidence of a substantial reduction in this pregnancy outcome in working black mothers. Since we saw little difference in adjusted risk in working versus non-working white mothers [Meyer, et al. 2008] it appears that working, or the unmeasured attributes that accompany work, such as pay, insurance, or social support, is an important factor in narrowing the gap in outcomes between black and white births. Our results in this respect are more consistent with those of Poerksen and Petitti [1991] in the Alameda County Study, who found that employment explained more of the variance in LBW outcomes than did other measures of SES.

However, even in comparing working populations, substantial differentials in outcomes still remain, even when comparisons are made by race within more-privileged socioeconomic groups. Increased risks for adverse pregnancy outcomes even in college-educated black women have been well described [Collins and Butler 1997, McGrady, et al. 1992, Schoendorf, et al. 1992, Colen, et al. 2006]. Our study confirms the results of these prior studies, in addition to corroborating the findings of McGrady and colleagues [1992] that adjustment for other SES variables, in our case occupational characteristics, did not reduce this risk. The reasons underlying the consistent findings that increased education alone does not yield improved outcomes for blacks remain unclear, but additional evidence for diminishing returns on education for other aspects of health has been noted in black adults [Farmer and Ferraro 2005].

The conclusion that we draw from the data presented here is that education and work, rather than representing two separate SES factors, are closely intertwined. If temporally ordered, with educational attainment preceding work, we might consider them instead two major components of a pathway that leads to socioeconomic differentials in pregnancy outcomes. This conclusion can be supported if one posits that healthy or rewarding work is characterized by the extent to which it draws upon past education and training, and allows one to act autonomously and commensurate with one’s acquired skills [Kohn and Schooler 1973]. Our data suggest this pathway may be impaired for Americans of African descent compared to their white counterparts, whereas it is not for Hispanics, despite a lower baseline of educational attainment. This finding confirms but also extends the findings of Davey Smith and colleagues [1998] who noted that both education and social class serve as indices of life-course socioeconomic experience, with respect to mortality and cardiovascular disease. They argue that education is important because of the opportunities it creates for improved material conditions of life that follow formal education, rather than particular specific effects upon health itself. Our findings may bolster this argument as applied to birth outcomes. Risk for LBW that varies with education in whites is unaffected by adjustment for work substantive complexity, suggesting that work characteristics track and extend educational attainment. The contrary results in blacks (and the evidence from Tables IV and V, that better education in blacks is not leading to commensurate work), may indicate that interference with this pathway, whether through reduced opportunity or discrimination [Krieger 2000] is a factor in the substantial differences in birth weight outcomes that we find. While its overall causes are likely multifactorial, our results also suggest one potential avenue for research into the Hispanic paradox, the finding that numerous health outcomes in US residents of Hispanic origin are improved over those of US blacks, despite their similarity in many indicators of socioeconomic status [Franzini, et al. 2001, Acevedo-Garcia, et al. 2007]. These results also extend, to an association with a specific health outcome, the findings of Miech and colleagues [2003] who similarly found little difference in trajectories of occupationally-based SES measures in Hispanics contrasted with whites once educational attainment was controlled, but found persistence of significantly lower values of these measures in blacks.

Our results are subject to several limitations. In particular, data on individual or family income, wealth, or resources is not available from this administrative dataset. Income and assets exhibit large differentials by ethnicity, and may have similar effects on birth outcomes as well as being correlated with occupation [Parker, et al. 1994, Finch 2003, O'Campo and Schempf 2005]. We are thus unable to assess whether a discrepancy between educational attainment and income similar to that which we see between education and occupation is present in our study population, and whether it may produce similar effects or confound the relationship between education and work characteristics. Other limitations are inherent in the use of a large administrative dataset and a cross-sectional study design to answer research questions such as those posed here, which were acknowledged in our previous work. These limitations include reliability of data on maternal occupation, and the restricted information available on covariates and potential confounders in the dataset. Important predictors of low birth weight, such as a previous occurrence, as well as other potentially important factors such as insurance coverage, are not available in the data. The coding of other available fields, such as smoking during pregnancy (limited to a yes/no answer) and education (truncated at 17 years) may reduce precision in testing hypothesized contributors to LBW, nor do we have data on the length of time mothers were employed in the job of record. Healthy worker or survivor biases may potentially affect results if pregnancy or its complications lead to subjects' differentially leaving the workforce. Lastly, imputed job characteristics from databases remain proxy and 'average' measures of exposure, and may not reflect either individual work circumstances, or changes in occupational stressors that may occur differentially across the course of pregnancy. However, as we have previously noted, despite these limitations, the magnitude and direction of risks attributable to the risk factors derived from our administrative dataset were consistent with those from other studies [Meyer, et al. 2007, Meyer, et al. 2008].

In summary, we find that maternal work appears to have a substantial positive effect on LBW outcomes in black and Hispanic women. Examination of educational attainment and occupational characteristics separately by race/ethnicity indicates some evidence for educational gradients in LBW in whites, while in blacks a disparity between occupational characteristics and education was a stronger predictor of adverse outcomes. Higher risk for LBW delivery is seen in blacks (compared with whites) at high levels of education, consistent with previous investigations. By contrast, differences in risk were considerably reduced in black women in work of higher substantive complexity when compared to whites. These data suggest that translation of education to work that engages past training and current skills may be of greater importance for health than educational attainment alone. Additionally educational attainment in black women may not be matched by work congruent with past training, possibly through reduced opportunities or discrimination. Further support is provided by the finding of equivalent (or better) work SC in Hispanic women once lower educational attainment is controlled and accounted for. This latter finding may arise from broader factors such as group cohesiveness posited as explanations for the Hispanic paradox. If confirmed by further work, these results suggest potential pathways through which previously-noted ethnic and racial disparities in birth outcomes may be reduced.

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TABLE I

Maternal demographic characteristics: Connecticut singleton births, 2000

		White non-Hispanic N= 25,550	Black non-Hispanic N= 3,980	Hispanic N= 4,960
		Count (%)	Count (%)	Count (%)
Age (10 year increments)	**20 – 29 years**	9121 (35.7)	2414 (60.6)	3456 (69.7)
	30 – 39	15323 (60.0)	1455 (36.6)	1423 (28.7)
	>39	1106 (4.3)	111 (2.8)	81 (1.6)
Tobacco use during pregnancy?	**No**	22594 (88.4)	3420 (85.9)	4253 (85.7)
	Yes	1920 (7.5)	323 (8.1)	338 (6.8)
	Missing	1036 (4.1)	237 (6.0)	369 (7.4)
Previous Birth	**No previous births**	9844 (38.5)	1114 (28.0)	1438 (29.0)
	Previous delivery	14485 (56.7)	2546 (64.0)	3136 (63.2)
	Missing	1221 (4.8)	320 (8.0)	386 (7.8)
Trimester prenatal care started	**1st Trimester**	23446 (91.8)	3114 (78.3)	3849 (77.6)
	2nd Trimester	1297 (5.0)	490 (12.3)	732 (14.8)
	3rd Trimester	215 (0.8)	101 (2.5)	153 (3.1)
	Missing	572 (2.2)	275 (6.9)	226 (4.6)
Educational level	**College or further (≥16 years)**	12634 (47.4)	628 (15.8)	595 (12.0)
	HS grad/some college (12–15 years)	11794 (46.2)	2807 (70.5)	2889 (58.2)
	Non-HS graduate (<12 years)	862 (3.4)	367 (9.2)	1225 (24.7)
	Missing	260 (1.0)	178 (4.5)	251 (5.1)
Occupation noted in dataset	**Yes**	18,207 (71.3)	2742 (68.9)	2480 (50.0)
Work substantive complexity (tertiles)	**High**	7049 (38.8)	420 (15.4)	305 (12.3)
(% of working mothers)	**Intermediate**	6641 (36.5)	840 (30.7)	738 (29.7)
	Low	4504 (24.7)	1474 (53.9)	1437 (58.0)

Figures represent singleton births listed in the Connecticut 2000 birth registry with maternal age 20 or greater, gestational age at delivery ≤ 44 weeks. Figures for substantive complexity exclude 25 working mothers with military service jobs

TABLE II

Low birth weight outcomes by education and substantive complexity, stratified by race/ethnicity.

		Low birth weight (%)			
		Total	**White non-Hispanic**	**Black non-Hispanic**	**Hispanic**
Occupation noted:	**Educational attainment**				
Yes	**≥ 16 years**	415 (4.0)	345 (3.7)	43 (8.1)	27 (6.6)
	12–15 years	637 (5.4)	406 (4.9)	143 (7.3)	88 (5.5)
	<12 years	79 (8.2)	29 (6.7)	26 (17.0)	24 (6.3)
No	**≥ 16 years**	94 (2.7)	78 (2.4)	9 (9.3)	7 (3.8)
	12–15 years	345 (6.0)	164 (4.6)	108 (12.6)	73 (5.7)
	<12 years	146 (9.8)	36 (8.4)	30 (14.0)	80 (9.5)
Work substantive complexity	**High**	318 (4.1)	274 (3.9)	25 (6.0)	19 (6.2)
	Intermediate	386 (4.7)	287 (4.3)	57 (6.8)	42 (5.7)
	Low	460 (6.2)	230 (5.1)	144 (9.8)	86 (6.0)

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TABLE III

Risk of low birth weight delivery, stratified by occupational status in birth dataset.

	LBW	
	Non-Working	**Working**
	OR (95% CI)	**OR (95% CI)**
Model 1		
White non-Hispanic	Ref	Ref
Black	3.62 (2.90 – 4.53)	1.92 (1.63 – 2.27)
Hispanic	1.90 (1.54 – 2.35)	1.29 (1.06 – 1.58)
Model 2		
White non-Hispanic	Ref	Ref
Black	3.53 (2.78 – 4.47)	2.17 (1.83 – 2.59)
Hispanic	1.99 (1.58 – 2.51)	1.49 (1.21 – 1.83)
Model 3		
White non-Hispanic	Ref	Ref
Black	3.07 (2.41 – 3.91)	2.06 (1.73 – 2.46)
Hispanic	1.61 (1.26 – 2.05)	1.36 (1.09 – 1.68)
Education		
≥16 years	Ref	Ref
12–15 years	1.69 (1.29 – 2.21)	1.29 (1.12 – 1.50)
<12 y	2.52 (1.79 – 3.54)	1.82 (1.34 – 2.46)

Model 1: unadjusted odds ratio from logistic regression analyses for low birth weight delivery in black mothers contrasted with whites.

Model 2: adjusted for maternal age (quadratic), tobacco use (Y/N), previous birth (Y/N), and trimester of initiation of prenatal care.

Model 3: additionally adjusted for educational attainment using ≥16 years (college graduate) as referent.

LBW – low birth weight delivery; OR – odds ratio; 95% CI – 95% confidence interval; Ref – Referent group

TABLE IV

Risk of low birth weight delivery by education and substantive complexity of work, examined separately by maternal ethnicity.

Low birth weight						
	White		**Black**		**Hispanic**	
	Univariate	**Final model**	**Univariate**	**Final model**	**Univariate**	**Final model**
Educational level	**OR (95% CI)**					
≥16 years	Ref	Ref	Ref	Ref	Ref	Ref
12–15 years	1.27 (1.07 – 1.50)	1.25 (1.04 – 1.51)	0.95 (0.64 – 1.40)	0.93 (0.53 – 1.62)	0.99 (0.59 – 1.66)	0.97 (0.55 – 1.70)
<12 y	1.25 (0.79 – 1.98)	1.21 (0.76 – 1.94)	2.31 (1.30 – 4.12)	4.80 (1.68 – 13.7)	0.90 (0.45 – 1.81)	0.88 (0.42 – 1.86)
Work SC						
High	Ref	Ref	Ref	Ref	Ref	Ref
Intermediate	1.08 (0.90 – 1.29)	1.01 (0.84 – 1.23)	1.13 (0.67 – 1.91)	1.11 (0.64 – 1.93)	1.11 (0.59 – 2.07)	1.07 (0.55 – 2.08)
Low	1.14 (0.93 – 1.40)	1.00 (0.80 – 1.26)	1.66 (1.03 – 2.68)	0.58 (0.18 – 1.84)	1.04 (0.58 – 1.88)	1.07 (0.46 – 2.06)
Interaction						
≥16 years x Low SC		NS		4.48 (1.24 – 16.2)		NS
12–15 years x Low SC		NS		2.75 (0.90 – 8.41)		NS

All ORs adjusted in logistic regression analyses for maternal age (quadratic), tobacco use (Y/N), previous birth (Y/N), trimester of initiation of prenatal care, and physical demands of work. *Univariate* column show ORs for education and SC calculated separately; *Final Model* column shows ORs with both included in the model and interaction terms between education and work SC assessed by backward stepwise logistic regression

Table V

Regression analysis of substantive complexity of maternal work by race/ethnicity (non-Hispanic whites as referent), maternal age, and educational attainment.

	Model 1	Model 2	Model 3
Intercept	33.7	13.0	12.2
Black	−3.0	−1.7	−1.6
Hispanic	−3.3	−1.4	4.1
Age	0.31	0.13	0.13
Age squared	−0.019	−0.005	−0.005
Education (years)		1.4	1.5
Hispanic x Education			−0.43
R^2 for model	0.181	0.362	0.364

Figures represent regression coefficients for predictors of substantive complexity. Maternal age was centered at the overall mean maternal age of 30 years and modeled as a quadratic function.

All coefficients shown were significant at $p<0.001$ or less

TABLE VI

Risk of low birth weight delivery for black and Hispanic mothers, relative to whites (reference category) stratified by substantive complexity of work and by educational attainment

Work SC	Black	Hispanic
	OR (95% CI)	OR (95% CI)
High SC	1.53 (0.96 – 2.43)	1.39 (0.80 – 2.39)
Intermed SC	1.69 (1.22 – 2.33)	1.39 (0.96 – 2.02)
Low SC	2.33 (1.82 – 2.97)	1.27 (0.94 – 1.69)
Educational Attainment	**Black**	**Hispanic**
≥ 16 years	2.24 (1.57 – 3.21)	1.53 (0.96 – 2.42)
12–15 years	1.72 (1.39 – 2.12)	1.29 (0.99 – 1.66)
<12 y	4.04 (2.13 – 7.69)	1.22 (0.64 – 2.30)

Odds ratios reflect risk of adverse outcome in working black mothers compared to whites as a referent. ORs adjusted in logistic regression analyses for maternal age, tobacco use, previous birth, trimester of initiation of prenatal care, and physical demands of work, and are also mutually adjusted for the other factor of interest (eg risk estimates for strata of SC are adjusted for educational attainment)